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XL.—ABRAHAM'S OAK.

M. PORTAL.

(With Plate.)

With reference to the note in the *Kew Bulletin*, 1919, p. 233, on Abraham's Oak, *Quercus coccifera*, var. *palaestina*, Boissier, I send a photograph of Abraham's Oak taken for me in 1918 by Col. Robins, D.P.M., E.E.F., after the capture of Jerusalem. This venerable tree is, as the photograph shows, protected by an iron railing, and its condition might be considerably improved could it receive the attention of a skilled forester.

The great rarity in Palestine of *Q. calliprinos** of any size is attributed to two causes—(1) perpetual grazing by flocks of goats on hillsides, (2) the scarcity of trees for fuel or building, combined with the methods adopted by the Turk for the raising of money. As one enters the pass up towards Jerusalem, one notes, climbing the mountain sides, numberless small plants of *Q. calliprinos* growing out of clefts in the rock, eaten close to the rock face by the flocks of goats, herded by small hill children. This has gone on for many hundreds of years, and thus the oak has never had a chance of developing.

It is difficult to explain how these small oaks have become established in the places where they now exist in the Judean hills, as no trace of an acorn-bearing tree or bush is to be found except near Enab, a considerable distance away. It is however, worthy of note that the Syrian jays are very fond of carrying away acorns in the cups from the clump near Enab, afterwards sitting on the top of a flat rock, trying to pick the acorn out. In that way some may drop out and fall in the clefts between the rocks. It is possible also that the herd boys may pick up a number of the acorns under the clump when they bring the goats down to eat the fallen ones, and take them away as playthings and drop them.

* This name is used here in preference to that given in the note referred to above for reasons stated in the article (No. XLI.), which follows.

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The Turk, desiring always to raise taxes with the least amount of trouble, puts a tax of £E1 per tree on certain trees of any size. A notable example of the effect of this tax is that of the Olive forest formerly existing between Gaza–Ascalon and Mejdel, still shown on our maps as "Olive forest."

When the advance came I went to see this "forest," but found only very large Olive tree stools, the whole having been cut down by the owners and the wood sold, thereby avoiding the annual tax of £E1 per tree!

An oak forest of considerable size is shown on the maps of 1878 behind El Jelil marshes, some 17 miles north of Jaffa, but this also has vanished, and, though some fair-sized tree stools remain, the rest is scrub and of no size. A better collection of *Q. calliprinos* existed recently near Zimmarin, about 20 miles south of Mount Carmel, but only scrub now remains, the Turk having cut the larger trees or saplings for firewood. At the dump I saw no log exceeding 12 in. in diameter. On the slopes of Mount Carmel this oak forms certainly four-fifths of the scrub, and one sees many bushes with thick branches 8 or 9 ft. long, growing out of the rocks on hill sides, in many cases bearing acorns. But these slopes are in many parts too steep even for goats, and no flocks appeared there such as we saw on the Judean hills. The oak forest below Zimmarin starts, apparently, where cultivation ceases, and extends up the lower foothills and eventually round the spurs of hills to the Carmel range, but never actually reaches the hill tops.

There is no reason why, in the fertile soil and good climate of Palestine, groves of *Q. calliprinos* and other trees should not be grown again and protected under Government supervision. It is particularly noticeable how successfully the German-Jewish Colonies have planted trees, usually Eucalyptus. The growth these have made in a comparatively short time is remarkable.

The country badly needs re-afforestation, which would, under proper care, soon be a paying proposition. The chief enemy would be the herds of goats or sheep, but these could be fenced off with barbed wire. On rare occasions flights of locusts occur which consume most of the green things they meet, but I did not see any *Q. calliprinos* scrub or Eucalyptus which showed signs of former attack by them. Palm trees, Olive trees and, of course, Almond trees had suffered severely, and in gardens which had been left to run wild the trees were often in a dying condition.

XLI.—THE BOTANICAL HISTORY OF THE 'SINDIAN' AND THE AGE OF ABRAHAM'S OAK.

O. Stapf.

The nomenclature of the species of *Quercus* to which the famous Abraham's Oak belongs is somewhat confused, partly owing to its having been described several times over, and partly on account of the broader or narrower view of the species which successive writers have applied to the group of which it is a member. The

following lines are intended as a contribution towards a clearer and, at the same time, practical concept of the type of oak in question.

As the Arabs of Palestine have long known it by the name "Sindian," we may, for the sake of greater clearness, speak here of it as the Sindian Oak, and thus keep it distinct from the Kermes Oak of South Europe and North Africa, with which it is frequently associated. Both belong to the "*coccifera*" group, *Quercus coccifera* being the name originally applied by Linnaeus to the Kermes oak. These "*Cocciferae*" represent a type of evergreen oak, widely distributed over the whole of the Mediterranean region from the Atlantic to the Levant. They form a characteristic element of the "maquis" or "macchie," that is, the scrub-formation of the coastland of the Mediterranean, ascending here and there in the adjoining mountain ranges to altitudes of up to over 4000 ft. Mostly shrubs from a few to 10 ft. high, they grow occasionally into small trees up to 20 ft. high, or, as in the eastern section of the area, into quite stately trees. The small, hard evergreen and mostly spinous leaves vary in size, shape and the degree of spinosity in the same individual, or in the individuals of a given colony, or, as it appears, from race to race. The fruits show a similar range of variation with regard to size, shape of the phyllaries or scales of the cupules, the length of the acorns relative to that of the cupule, and the time they take to mature. Here the variation is partly of the nature of response to conditions of nutrition or possibly age, individual fluctuation, or of a fixed character indicating the presence of distinct generic units. This partly real and partly apparent instability of the characters which challenge discrimination is very difficult to appreciate in detail, and apt to lead to one of the two extremes of taxonomic treatment, excessive "lumping" or excessive "splitting." Both have had their apostles. The conception of one extremely "variable" or polymorphic *Q. coccifera*, covering the whole group, is contrasted with the creation of almost a score of species proposed in the course of time for this same group. In either case it seems that too much has been merely assumed, and it will require prolonged observation and experiment to disentangle the stable and the unstable element in this apparent chaos of forms. No attempt in that direction is made here, but, viewing the material at my disposal, I have come to the conclusion that so far only one type of the *coccifera* group is known to exist in Palestine. It occurs either as a shrub or a tree of varying and occasionally considerable size; it has leaves, no doubt, of variable size, but on the whole larger and more oblong than those of the Kermes oak, and its fruits have large to very large cupules with rather long linear- or lanceolate-oblong phyllaries or scales, mostly free from the middle upwards and erect or more or less recurved and covered with a fine greyish down. This oak is a common, if not the most common, constituent of the scrub or the maquis formation which occurs all over the southern and western slopes of the Judean plateau from the latitude of Hebron to Mount Carmel, entering here and there deeply along the valleys into the

latter, then covers much of the hills around the plain of Esdraelon, and finally continues northwards, facing on one side the Phoenician plain and merging on the other in the richer woodlands of Upper Galilee and the Lebanon. Tristram also records it from Gilead on the other side of the Jordan, but I have not seen any specimens from there. Farther north, however, at Banias, it was collected by Post, and, according to Kotschy, it also occurs in the Antilebanon. Beyond this region it extends through the Jebel Nur into the Cilician Taurus, here, as in the Lebanon, ascending to over 4500 ft. It has also been found in Cyprus from the coast hills to the mountains of the interior. The Arabs distinguish this oak, as has already been stated, as Sindian. Dr. E. Robinson records this name for the Abraham's Oak of Hebron and a similar tree at Seilun (Shilo) in Samaria. Brocchi heard the same name applied to the "*coccifera*" oak of the Lebanon, and Sindyaneh or Sendianeh, N.E. of Kaisariyeh, near the Zimmarin of Major Portal, derives, no doubt, its name from the same vernacular. This oak has been repeatedly figured.

Linnaeus had evidently no first-hand knowledge of the Palestine Oaks*. The only reference to them is in Species Plantarum, ed. ii., 1413, where Judaea is quoted among the habitats of *Quercus coccifera*. This he had from Gronovius (Flor. Or., 1755, p. 119), who, in turn, quotes Rauwolf. The latter (Beschraib. Raiss. Morgenl. 1583), mentions "Ilex minor" from the hills above Tripolis (p. 59) and "Ilices" from east of Rame (p. 460). Belon, who was at Rame about 27 years before Rauwolf, mentions them as "Chênes verds." It was not until 1812 that this oak received critical attention, when Labillardière, who had collected it himself in the Lebanon, described and figured it, identifying it, however, with Desfontaine's *Q. pseudococcifera* from Algeria. Then in 1838 Webb, pointing out its distinctness from the Algerian plant, named it *Q. calliprinos*. Unfortunately he included in this species an oak of which he had collected some imperfect material in the mountains near Tetuan in Morocco. Th. Kotschy, during his travels in the Orient in 1853 and 1855, paid much attention to the oaks and amassed considerable material for study, which was distributed generously and was also to form part of the basis of a monograph of the European and the Oriental oaks. He was evidently much impressed by certain differences, particularly in the structure of the cupule, and without careful collation attached freely new names to the specimens he dispersed. Some of them remained "nomina nuda," although they were quoted by subsequent writers or used for the designation of subordinate forms. Others he connected with very full descriptions and splendid

* Strand, in his Flora Palaestina, usually quoted Linnaeus, Flora Palaestina (Amoen. iv. 1756), enumerates five species of *Quercus*, one of them *Quercus coccifera* of Rauwolf's collection, the others "a Pocockio in Palestina collectas e a D. Millero extricatas." They are evidently the oaks listed by Pococke in his "Description of the East," vol. ii. p. 187, under Tournefortian diagnoses taken from Tournefort's Corollarium. What these correspond to we do not know; but it is very improbable they were based on Palestine specimens, and have evidently nothing to do with the Abraham's Oak. I have not been able to trace Pococke's specimens.

figures in his folio "Die Eichen Mitteleuropas und des Orients," which appeared in parts from 1858-1862. In this work he distinguished four species of the "*cocciferae*," which he recognised as a group "Phyllocentron" among the evergreen oaks of his section "*Mesolepidium*." Among these *Q. palaestina* covered the Oak of Hebron, whilst the corresponding oak of the Lebanon is not accounted for. *Q. palaestina* is also mentioned by Kotschy as growing around Hebron, in a paper on the spring flora of South Palestine (in Verh. Zool.-Bol. Ges. Wien, 1861, 16); but in two later papers, "Der Libanon und seine Alpenflora" and "Die Sommerflora des Antilibanon" (ibid. 1864), he mentions *Q. calliprinos* (pp. 451, 455, 748) and *Q. pseudococcifera* (pp. 748, 764), and identifies the latter with the "Sendian" of the natives. Thus Kotschy's account of the "*Cocciferae*" remains incomplete and confused; but it seems as if he had meant at some time to extend his concept of *Q. palaestina* so as to include more northern representatives, for he distributed specimens collected on Jebel Nur (Nur Dagh, S.E. Cilicia), in 1859 under the name "*Quercus palaestina*." It was only a few years after Kotschy's travels in Palestine and the Lebanon that Sir J. D. Hooker (1860) visited the same regions. He, too, studied the oaks of the Holy Land in the field as well as in the Herbarium. With much of Kotschy's material before him, he came to the conclusion that there was only one prickly evergreen oak in Palestine, very closely allied to the Kermes oak, but still sufficiently different to require a distinctive name. Although considering the differences as "no more than enough to establish a variety upon," he decided for Labillardière's name *Q. pseudococcifera*, quoting, however, Desfontaine as its author. With this inclusion the area of the Syrian oak was extended automatically to Algeria and the Iberian peninsula, and its distinctiveness practically obliterated. Hooker's paper was read before the Linnean Society in June, 1861, and printed the same year. Three years later (Nov., 1864) followed A. De Candolle's exhaustive monograph of the *Cupuliferae* (Prodrom. vol. xvi. ii.), in which an elaborate attempt was made to classify the numerous forms of the "cocciferae" which had by that time been distinguished in one form or the other. It resulted in the recognition of three species, *Q. coccifera* with the Kermes oak, and *Q. calliprinos* with the Sindian as leading types, and *Q. Fenzlii* based on the oak figured by Kotschy under that name. Eight varieties were recognised under *Q. coccifera*, and ten under *Q. calliprinos*. Desfontaine's *Q. pseudococcifera* was transferred as a var. *pseudococcifera* to *Q. coccifera*, and Webb's specimen of *Q. calliprinos* from Tetuan, to another variety (queried) of *Q. coccifera*, namely, *tomentosa*. *Q. calliprinos* was thus confined to the eastern part of the Mediterranean region ("In orientali regione Maris Mediterranei"), and all the Palestine and Syrian "cocciferae," with the exception of *Q. Fenzlii*, oaks came now under this heading. Kotschy's *Q. palaestina*, as described and figured by him on tab. xix. of his monograph, is quoted as a synonym of var. *arcuata*, a name originally used by Kotschy himself on one of his distribution labels. The Lebanon form of Labillardière, as

already stated, constitutes the nucleus of the species, whilst other forms are described as distinct varieties, namely (γ) *inops* (Lebanon, *Kotschy*), (δ) *consobrina* (Beirut and Lebanon, *Kotschy*), (ζ) *brachybalanos* (Beirut, Carmel, etc., *Kotschy, Bove, Gaillardot*), and (ι) *pachybalanos* (Carmel, Tabor, *Gaillardot*). To judge by the authentic specimens of those varieties which I have seen, I can see in them nothing but unstable fluctuations or races not worthy of being distinguished at present. For practical and especially economical purposes, at any rate, they may be safely considered as a specific unit, which, under the existing rules of nomenclature, would have to be given the name *Q. calliprinos*. De Candolle's account of *Q. calliprinos* implies a considerable extension of the species beyond Syria and Palestine, through the Taurus and Western Asia Minor to Constantinople, and to Cyprus, Crete, and the island of Zanthe; but from the material I have been able to examine I am inclined to restrict the area in its western and north-western extension to Cyprus and the Cilician Taurus.

As to *Q. Fenzlii*, some difficulty arises from a certain discrepancy between the original description and figure (Kotschy, Eich. Mittel Europ. Orient, t. 24), and the specimens distributed under that name. Kotschy states that the oak in question was collected "in regione montana Xyftlic" above Tarsus in Cilicia, between 3500 and 4000 ft., and distributed under the Nos. 397 and 398, and that it was distinguished by its small delicate (zart) leaves* and closely compressed phyllaries or cupular scales. The specimen numbered "Kotschy, It. Cil. 398" and localized "in regione montana Zyftlik" at Kew is, in my opinion distinctly *Q. calliprinos*, with an immature acorn whose cupule has phyllaries typical of the species and just beginning to spread out. They are neither as short nor as appressed as shown in the plate. No. 397 of the same set, at Kew, was distributed as *Q. calliprinos*, Webb. It is stated to have been collected "in regione montana prope 'Gullek Boghas'" in the Cilician Taurus at 4000 ft. Both are dated Sept., 1853, and the altitude given for both is 4000 ft. No. 397 is laid out very amply and is undoubtedly *Q. calliprinos* with acorns in a more advanced state. Neither specimen corresponds exactly to Kotschy's figure of *Q. Fenzlii*.

Kotschy, in his book "Reise in den Cilicischen Taurus," enumerates *Q. Fenzlii* on p. 381 as occurring "in collibus cretaceis, bis zu 2000," and on p. 369 he says that it descends in the hill zone—the upper limits of which he places at 2000 ft.—to 1000 ft., whilst *Q. calliprinos* (p. 370) occurs from 2000 ft. upwards. In the "Höhen-tableau" at the end of the book *Q. Fenzlii* and *Q. Calliprinos* are entered under the same number in the 1000–2000 ft. zone in the margin and in the 1000–2000 and 2000–3000 ft. zones in the panorama. Moreover, "Zyftlik" on the shoulders of Hadschin Dagh, east of Gülek gala was not visited in September, as the label says, but on August 24 and 25, and no mention of *Q. Fenzlii* is made in the account of that excursion. Yet *Q. calliprinos* was collected on that occasion and distributed

* In the description the leaves are described as "subcoriacea rigida."

as No. 40 "*Quercus calliprinos*, Webb, var." To unravel the confusion it will be necessary to see the original field labels. At any rate, so much is certain that the Sindian occurs in the Cilician Taurus and that *Q. Fenzlii* is either in part or *in toto* identical with it. I may here add that Kotschy collected in the same region another oak of the "*coccifera*" group which he identified with *Q. rigida* of Willd. (Spec. Pl. iv. 404), and figured on t. 8 of his folio work. It has all the appearance of *Q. calliprinos* except for the usually intensely glaucous underside of the leaves. Willdenow's plant was collected by C. Schwarz in "Caramania," which means no doubt in this case the western continuation of the Cilician Taurus and its foothills. A. de Candolle (l.c. 56) reduced it to a variety (K) of *Q. calliprinos*, and it may indeed represent only an excessive xerophytic condition of the latter. According to Kotschy it is not uncommon near Gülek Boghaz.

Boissier (Flor. Or. iv. 1879; p. 1169), treats our oak under the varieties *calliprinos* (including *Q. Fenzlii*), *pseudococcifera* and *palaestina* of *Q. coccifera*, distinguishing them mainly by the phyllaries whether they are erect and more or less appressed or more or less spreading or squarrosely recurved or finally "eximie retrofractae." Post (Flor. Syria and Palestine, 1896; p. 739), follows Boissier, including, however, the var. *palaestina* under var. *pseudococcifera*.

It seemed worth while to make an attempt to get at an approximate estimate of the age of the famous Sindian of Hebron. For that purpose the following data were available. J. D. Hooker on the authority of Porter who measured it about 1850, gives the girth of the trunk of the tree as 23 ft. A somewhat excentric section of a trunk or more likely a branch of a Sindian oak from Hebron in the Museum at Kew (Vester coll. no. 34), has 37 annual rings. The first 10 rings show over the longest radius an annual average increment of 3 mm., the following 5 of 1·9 mm., and the remaining 22 which are fairly evenly distant of 1·5 mm. Assuming that the trunk of the tree grew after the first 30 years at an average rate of 1·5 mm., the age of the tree may be estimated roughly at 700 years. This would make the date of the starting of the tree the year 1150 or thereabouts, that is the time of the Second Crusade. It is therefore not surprising that we hear nothing of it for a very long time after. Even Belon, a very keen observer and naturalist, who visited Hebron in 1548 does not mention it, although the diameter of the trunk of the tree must have then measured about 4 ft. with a girth of about 13 ft. At that time it would have been, as oaks go, a fair-sized, but by no means very striking tree, particularly if, as we may assume, large trees were then less rare in Palestine than they are now. This, however, is certainly not the full explanation of Belon's omission to mention the tree. It is rather to be sought in the fact that in those days the legend of the Abraham tree attached to a Terebinth (*Pistacia Terebinthus*). This is what Belon (Observ. Plus. Singul. p. 145 *verso*), says—"Le lieu ou Abraham estoit lorsqu'il en veit trois et en adore un. Tres vidit et unum adoravit, nous fut monstré hors le village d'Ebron, dessus le fossé d'un

champ oú fût creé Adam et est merqué d'un Terebinthe, qui a trois arbres sortant d'un tronc." This field was evidently not the same where the present Abraham's oak stands, but farther north where the Jewish tradition has for a long time located the house of Abraham in Mamre. (*See* Ritter, Erdkunde, XVI. iii. 225.) When this terebinth disappeared is not known; it does not seem to have been seen by the numerous travellers who visited Hebron after Belon. But it seems that following on its destruction the tradition of Abraham's house was transferred to the great Sindian oak to the west of the present Hebron.

Some kind of tree cult seems to have been attached to the great trees of Hebron since the earliest times, perhaps as a relic of real tree worship. It has been suggested (Rosenmüller, Bibl. Naturg. 232), that the old Hebrew word for them, Allon or Aelon, signified originally any big tree, just as "oak" is frequently used in the same sense. If that is so, the oak and the terebinth must always have had the monopoly of the claim to that name although we may not be able to decide which of the two was Abraham's tree.

XLII.—ARCEUTHOBIUM OXYCEDRI AND ITS DISTRIBUTION.

W. B. Turrill.

The generic name *Arceuthobium*, M. Bieb., Fl.Taur., 3, p. 629, 1819, is one of the Nomina Conservanda of the Vienna Rules, being antedated by *Razoumowskia*, Hoffm. Hort. Mosq., 1808. This latter name is used by many authors, especially American, instead of *Arceuthobium*. About 18 species are known, all except four being confined to North America. The genus is allied to *Viscum* but is well distinguished by the anthers being distinct from the petals and not adnate to them for the whole or greater part of their length.

An interesting account of the genus entitled "Überblick über die Arten der Gattung *Arceuthobium* (*Razoumowskia*) mit besonderer Berücksichtigung ihrer Biologie und praktischen Bedeutung" by C. von Tubeuf, has recently appeared in Naturw. Zeitsch. Forst- und Landw., 1919, pp. 167-273. This paper deals more especially with the anatomical, physiological and practical questions connected with the genus and is chiefly concerned with American species. The distribution of the extra-American species is not given in detail and two of the recently described ones are not mentioned. A long bibliography is appended.

Of the four species not found in America three can be briefly referred to here. *Arceuthobium minutissimum*, Hook. f., is limited to Kashmir and Nepal, where is occurs on *Pinus excelsa*. It is one of the smallest Phanerogams known, being only 2–5 mm. in length. *A. chinense*, Lecomte in Not. Syst., vol. iii. p. 170 (1915), is parasitic on *Abies* in the province of Yunnan. *A. Dacrydii*, Ridley in Journ. Fed. Malay States Mus., vol. vi. p. 170 (1915), is parasitic on *Dacrydium Beccarii* "near the camp on the Padang," Gunong Tahan, Pahang.

The species with which we are now chiefly concerned is *Arceuthobium Oxycedri*, M.Bieb., l.c., a plant having a wide distribution in the Mediterranean Region and well known as a parasite on various junipers. The following list of localities from which it has been recorded has been made as complete as possible. An exclamation mark indicates that the writer has seen a specimen from the place named.

Spain. Old Castile, Cabreros! Near El Escorial and near S. Lucar de Barrameda (Willk. et Lange, Prod. Fl. Hisp. vol. i. p. 24).

France. Basses Alpes, Sisteron! Several localities between Sisteron and Montpezat (Rouy et Fouc., Fl. de Fr., vol. xii. p. 284). Hautes Alpes, Ribiers! Var, several localities (Alb. et Jahan, Cat. Pl. Var, p. 422). Bouches-du-Rhône, Mimet, Marseille (Rouy et Fouc., l.c.).

Istria. Distr. Capodistria, between Brezzi and Puzzole! Carcauzze! Near Corte d'Isola, on the eastern slopes of the Vanderinga Valley and near Borutto (Pospichal, Fl. des Oesterr. Küstenl., vol. i. p. 421).

Croatia. Zengg (Beck, Illyr. Länder, Engl. u. Drude, Veg. der Erde, vol. iv. p. 73).

Dalmatia. Near Fiume! Between Buccariza and Porto-Ree!

Epirus. Near Syraku, at the foot of Mt. Peristeri (Halácsy, Conspec. Fl. Graec. vol. i. p. 696).

Albania. Distr. Hoti, Bukovik! Distr. Janina, between Paleochori and Syrareon! Mt. Tomor!

Greece. Mt. Oeta! Mt. Parnassus! Thessaly, near Chaliki, Krania, Klinovo, Sermeniko in Pindus (Halácsy l.c.).

Macedonia. South Macedonia, without precise locality! Xerolivadon (Vándas, Reliq. Formanek., p. 251).

Serbia. Kopaonik, Stol, and Čačaker (Beck, l.c. p. 93).

Bulgaria. Above Stanimaka (Velenovsky, Fl. Bulg. Suppl. i. p. 140).

Azores. Mt. Pico!

Algeria. Prov. Oran, Vaida! Near Batna! Gharrouban! Dhaya! Lella-Khadidja, Teniet, Aures, etc. (Batt. et Trab. Fl. de l'Alg., p. 786).

Asia Minor. Amasia, Ak Dagh! Taurus, Cilician Gates! Sivas.

Syria. Lebanon, Amanus and Akher Dagh (Post, Flora of Syria, Palestine and Sinai, p. 712).

Armenia. Riltzagadsch! Alliper Dagh!

Kurdistan. Oroomah!

Caucasus. Tiflis!

Crimea. Sudak, Mt. Pertsch!

N.E. Persia. Near Radkan (Boiss. Fl. Or. vol. iv. p. 1068)

Punjab-Himalaya. Lahul!

Tropical Africa. Aberdare Mountains!

The plant has also been said to occur in Portugal and Corsica, but no specimens have been seen from these countries by the writer, nor have trustworthy records been traced. The *Arceuthobium Oxycedri* of Hooker, Fl. Bor. Amer., vol. i. p. 278, tab.

xcix., appears to be chiefly *A. campylopodum*, Engelm., though the plate also contains figures of the European *A. Oxycedri*, M. Bieb. A good figure with dissections of the European *A. Oxycedri* is to be found in Reichb., Ic. Fl. Germ., vol. xxiv. tab. 141.

The Tropical African locality given above is of exceptional interest since the plant has not previously been known to occur outside the Azores, the Mediterranean Region, and Western Asia. The specimen was collected by Mr. W. J. Dowson on the north-western slopes of the Aberdare Mountains in British East Africa, at 6500 ft. altitude, growing parasitically on *Juniperus procera*, Hochst. This juniper has been fully dealt with in the Flora of Tropical Africa, vol. vi. Sect. 2, p. 336. It is the only species of the genus occurring in Tropical Africa and is widely distributed in Eritrea, Abyssinia, Somaliland, Uganda, British East Africa and Nyasaland. The tree is a most valuable timber tree in East Africa, as indicated by Hutchins, Rep. Forests on Kenia in Col. Rep. Misc. No. 41 (1907), p. 15. Since *Arceuthobium* is a parasite comparable in its effects on the host to the mistletoe and other Loranthaceous parasites its presence in East Africa may be of some economic importance.

In connection with the record of *Arceuthobium* on the Aberdare Mountains, a paper on "*Fomes juniperinus* and its occurrence in British East Africa," by Miss E. M. Wakefield in the *Kew Bulletin*, 1915, p. 102, may be mentioned. *Fomes juniperinus* is there recorded for the first time on *Juniperus procera* in East Africa. Its previously known distribution was United States and Russia. The geographical distribution of fungi is known often to be erratic, but the partial coincidence in distribution between the two juniper parasites *Arceuthobium* and *Fomes juniperinus* is interesting.

It is well known that *Arceuthobium* has explosive or sling fruits. A paper by Dr. T. MacDougal in Minnesota Botanical Studies, vol. ii. p. 169, 1899, deals in detail with the explosive mechanism of an American species. The American representatives of the genus like the Old World ones have very local and discontinuous distribution, and in this connection the methods of seed dispersal have to be carefully considered. In MacDougal's paper, quoted above, it is pointed out that the only localities which offer suitable conditions for the germination of the seeds are the tips of branches or the shoots of young trees underneath, and no animals are to be found in the habitat of the parasite which would in ordinary usage carry the seeds to these locations. Studies in Northern Arizona showed that the distribution has a direct connection with the vertical movements of the air. Rising air expands and cools, and in consequence the dew point is lowered or the relative humidity increased. This gives a condition most favourable for germination of the parasite, which is found in abundance along the margins of hills and the rims of cañons.

E. Heinricher, in Centralbl. f. Bakteriobiologie, vol. xlii. p. 705, 1915, states that the seeds of *Arceuthobium* will only germinate under the following conditions: presence of a living

or organic substratum, light, and a chemical stimulus (probably that provided by cellulose). Other authors have urged the importance of moisture or even liquid water for germination.

The explosion which accompanies the destruction of the fruit will shoot the seed some 30 to 40 ft., but some other cause must account for the wide and discontinuous distribution of *Arceuthobium Oxycedri*. There is no evidence that the fruits are eaten by birds, but the possibility of an exploding fruit hitting a bird must be considered. The likelihood of this happening is decidedly increased by the fact that the jerk of a bird alighting on a slender branch would cause all the mature fruits near to explode and to scatter their seeds in all directions. Many species of birds are widely spread in the Mediterranean Region, and the long migrations of some species would enable them to transport seeds stuck to them for great distances. Thus, a colony of the Yellow Wagtail (*Motacilla campestris*), is found from South-East Russia to Turkestan in summer, and winters in South Africa. The chances seem in favour of such a bird now and again getting a sticky seed, such as one of *Arceuthobium*, stuck to its feathers and getting rid of it either en route or at its destination. That *Arceuthobium* is not more widely distributed by this means is probably due to its dependence on a narrow range of host-plants and on certain conditions for germination, but it is difficult to see how its spread to Tropical Africa can be otherwise explained. Warming, "Botany of the Faeroes," pp. 676–678, gives very strong evidence against birds acting as regular fruit and seed dispersal agents over long distances, but it is to be noted that the observations quoted were all made in the colder North Sea area, and in any case do not eliminate the possibility of occasional transport by birds from one country to another. As regards the discontinuous distribution of the genus *Arceuthobium* in the North Temperate Zone a classification of it with the "Tertiary Relicts" which are so conspicuous a feature in any analysis of European vegetation is suggestive. However, from what has been said above, it seems more reasonable to think of *Arceuthobium Oxycedri* with its distinctive method of seed-dispersal apart from the majority of such Tertiary relicts as *Forsythia*, *Ramondia*, etc., and to conclude that it owes its present discontinuous distribution, in part, at least, to causes still working rather than to changing climatic and topographic conditions having broken up a once continuous distributional area. It is, of course, extremely probable that the wide gap between the Tropical African and Mediterranean or Asiatic stations will be more or less bridged by the discovery of *Arceuthobium* in intermediate localities, perhaps on the junipers of Eritrea, Somaliland, Abyssinia or South Persia.

That *Arceuthobium Oxycedri* is not alone among Mediterranean plants found on Tropical African mountains is evident from a study of their flora. Thus, Engler, in a paper in the Annals of Botany, vol. xviii. p. 523 (1904), records the following species or genera with closely allied species which occur both in the Mediterranean Region and in Tropical Africa: *Luzula*, *Anthoxanthum*, *Koeleria cristata*, *Arabis*, *Subularia*, *Stenophragma Thalia-*

num, *Cerastium*, *Sanicula europaea*, *Sambucus*, *Veronica*, and *Populus euphratica*. To these might be added *Erica arborea*.

Guppy, who was the first to record *Arceuthobium Oxycedri* from the Azores ("Plants, Seeds and Currents in the West Indies and Azores," pp. 426–427) comes to the following conclusion: "It is thus likely that birds actively disseminate the species, carrying the seeds firmly adhering to their plumage. In this respect *Arceuthobium* resembles *Luzula* . . . and it is noteworthy that the two genera have a similar distribution."

The genus *Arceuthobium* has not been definitely recorded in the fossil state, but *Loranthacites succineus*, Conw., *Patzea Johniana*, Conw., and *P. Mengeana*, Conw., described and figured by Goeppert, Menge und Conwentz, Flora des Bernsteins, pp. 135–138, tab. xiii. ff. 6–20, could well represent the ancestors or relatives of our genus, though, since the structure of the fruit is unknown, nothing can be said definitely on this subject.

The following species of *Juniperus* have now been recorded as host-plants of *Arceuthobium Oxycedri*: *J. Oxycedrus*, *communis*, *rufescens*, *drupacea*, *Sabina*, *brevifolium* (Azores) and *procera* (Trop. Afr.).

XLIII.—THE ARBORETUM AND PINETUM AT BICTON.

W. J. Bean.

Sixty to eighty years ago no garden in the south of England was more famous than that at Bicton. It owed its fame then chiefly to the excellent cultivation carried on there of orchids, stove and greenhouse plants, pine-apples and other indoor fruits, as well as to its flower gardening in the open air. At the present time the pilgrim to Bicton is attracted thither chiefly by its collection of conifers.

But the garden proper is full of charm. Largely formal in character, it has that serene dignity which comes with age to all such gardens designed at the outset on broad, adequate lines. There are no irritating trivialities here, unless one takes exception to a row of bay trees severely trimmed to low standards, each a naked stem surmounted by a bun-shaped top of branches. The garden is situated on a slope, and the lower section is an arrangement of water at different levels, canalised and in rectangular pools, with smooth perfect lawns between, the whole diversified by ancient Irish yews and some beautiful old leaden statuary. The garden is enclosed on each side of the slope by high walls clothed with vegetation, outside which lofty trees make a perfect frame for the whole.

The Bicton of early Victorian days was the home of Lord Rolle, an ardent patron of horticulture, to whom tree-lovers of our own time are indebted for the foundation of the magnificent Pinetum about 1841. Unhappily he died, comparatively young, in 1842, probably before the planting was completed, but the work he initiated was vigorously carried on by Lady Rolle, his

widow, who lived until 1885. At her death the property came to the late Hon. Mark Rolle, from whom it passed to Lord Clinton, the present owner.

In old accounts of Bicton, the collection of conifers and hardy trees and shrubs was said to occupy between thirty and forty acres. As some new ground has in late years been planted with conifers by Lord Clinton, the area is no doubt greater to-day. The arrangement is unusual and interesting. The collection of broad-leaved trees and shrubs occupies a comparatively narrow grassy belt surrounding one section of the park. This belt is enclosed on each side by an iron fence and is traversed by a gravel path, between which and the fence the trees and shrubs are planted on either side. The arrangement is one probably unique in a private garden in this country, and is particularly interesting to one with a Kew training, for it is purely botanical and the plants come in sequence in their genera and natural orders. Near the house a commencement is made with what, in 1840, were considered the "early" orders, such as *Magnoliaceae*, *Ternstroemiaceae*, etc.; passing on in succession through the *Leguminosae*, *Rosaceae*, etc., we come to the "later" ones, including such trees as elms, birches, planes, oaks and poplars, until finally, after traversing a roughly circular route for about 1½ miles the Pinetum is reached. The *Coniferae* are not confined to a comparatively narrow belt, like the broad-leaved trees and shrubs, but occupy a widespread undulating and picturesque site, between the hills and hollows of which are pleasant winding walks. Leaving the Pinetum one reaches the formal garden previously alluded to, and the precincts of the house again.

The Arboretum, as distinct from the Pinetum, has not been maintained in late years, and many species originally planted there have no doubt disappeared. Nor is the soil apparently so good as that occupied by the conifers. So that whilst there are numbers of finely developed broad-leaved trees and shrubs well worth more study than I was able to give them in one visit, they have not the attraction that the magnificent firs, pines and spruces possess. In the Pinetum one walks amongst an assembly of trees 60 to over 100 ft. high, probably unrivalled in England in their combination of size and variety.

Pines.—Of the genus *Pinus* there is a particularly fine collection, although a considerable number of the older trees show signs of failing. Many of the names under which they are grown are no longer in vogue.

In the south-western maritime counties, *Pinus radiata* (*P. insignis*) is very often remarkable for its fine development, but there cannot be many so fine as one at Bicton. It is probably the same as one measured by Mr. Elwes in 1902, which was then 75 ft. high and about 15 ft. in girth; I made its finely rugged trunk to be now 18 ft. in girth. Not far from this tree is one of *P. contorta* (here grown under its synonym *P. Bolanderi*), a very healthy, shapely tree with a trunk 7 ft. 6 in. in girth. There are but few examples of the true pitch pine of the S.E. United States (*P. australis*) in this country, and the one in this

collection must be amongst the largest; it is an old, rugged specimen with the characteristic long leaves in conspicuous tufts at the ends of the branches, its trunk 4 ft. 4 in. in circumference. Of the sugar pine (*P. Lambertiana*), whose wonderful cones are sometimes 21 in. long, there is a fine tree 80 to 90 ft. high, its trunk girthing 9 ft. 4 in.; this tree occasionally bears cones. The Jack pine (*P. Banksiana*), although introduced nearly 120 years ago is not common in England in any great size; here is one over 30 ft. high, bearing many of its curious small cones tapered and curved at the end and retaining them on branches several years old. Of a series of forms of the white pine (*P. Strobus*), one of the most noteworthy is a tree of the var. *nivea* of slender, pyramidal form, its grey smooth trunk girthing 5 ft. The western representative of the white pine in North America is *P. monticola*, of which there is here a fine tree 80 to 90 ft. high with a trunk 6 to 7 ft. round. A specimen of *P. ponderosa*, although scarcely so impressive as the famous tree at Bayfordbury, in Hertfordshire, must be one of the finest in this country; I estimated its height to be about 90 ft., and its trunk measures 9 ft. 5 in. in circumference. One of the least imposing of pines is the Jersey, or scrub, pine (*P. virginiana* or *P. inops*), from the Eastern United States, and it is rarely planted now; at Bicton a tree of spreading habit and horizontal branching is 4 ft. 8 in. in girth of trunk.

Of the Mexican pines the most notable in this collection, perhaps, is *P. patula*. It is only in the south-western counties of England and in places with a similar climate that this species can be seen in really good condition, but there its long, slender, pendulous grey needles make it one of the most distinct of all pines; at Bicton there is a very good example over 50 ft. high dividing near the ground into two great limbs, beneath which the trunk measures 11 ft. 9 in. in girth. From Mexico also comes *P. Ayacahuite*, represented at Bicton by probably the finest tree in England; it is apparently over 70 ft. high, canopied with rich green foliage, its trunk girthing 10 ft. 2 in. A tree grown as *P. Don Pedri* is also *P. Ayacahuite*. A third Mexican pine is *P. Teocote*, bearing its long, stiff, spreading leaves in threes, a tree at Bicton is over 60 ft. high, its trunk 7 ft. in girth; this tree is extremely rare in cultivation. A commoner one, also Mexican, is *P. Hartwegii*, sometimes regarded as a short-leaved variety of *P. Montezumae*. Of two trees at Bicton one approaches 80 ft. in height and is about 6 ft. round the trunk. This is probably the hardiest of the Montezumae group of pines, and there is a good tree in Windsor Forest. Under the name of *P. Devoniana* there is a tree of the true *P. Montezumae* 25 ft. or so high.

Among European pines none is more interesting than a specimen of the Macedonian pine, *P. Peuke*, which is undoubtedly one of the best in Britain; it is 50 ft., or perhaps more, high, its trunk 5 ft. 1 in. in girth. Although closely allied of *P. excelsa* this pine is very distinct in its slender pyramidal habit and closer growth. *P. Laricio* is represented by a fine series of forms of that variable species, many of the trees being of very large size. Of

the maritime pine (*P. Pinaster*), I noted two trees of particular interest, one named var. *Hamiltonii* was 8 ft. 9 in., the other, var. *dictrilis*, 9 ft. 11 in. in girth of trunk. A pine called *P. altissima* belongs probably to *P. Pinaster* also.

Silver Firs.—No trees enjoy the soft, moist climate of the south-western counties more than the silver firs, and on the whole they are better developed at Bicton than the pines. For this country many of them are giants, and more than any other conifers they help to produce the deep shady masses of vegetation whose luxuriance is so impressive at Bicton. Of the American species the two finest are *Abies Lowiana* and *A. grandis;* a tree of the former has a trunk 10 ft. in girth, and I judged it to be between 80 and 90 ft. high; whilst of the latter, one is 10 ft. 6 in. in girth and perhaps 10 ft. higher than the *A. Lowiana*. One of the rarest of silver firs to be seen in fine condition in the British Isles is *A. amabilis* (it grows naturally to upwards of 200 ft.); at Bicton it is only 25 ft. high, but very healthy. *A. bracteata*, so remarkable for its long needle-pointed leaves, its large brown buds and formidably armed bracts, is represented by two trees, but neither is very healthy, although the larger one is perhaps 45 ft. high.

Of the Old World firs the finest at Bicton is a superb example of *A. cephalonica*, its trunk 16 ft. in girth; in the bulk of timber it contains this tree is probably unequalled amongst its kind in this country. The allied *A. Pinsapo*, most distinct of European firs and confined in a wild state to a comparatively small mountainous region in the south of Spain, is in good health, one tree being 14 ft. 6 in. in girth of trunk, its head of branches making a fine pyramid 55 ft. high. There are finer trees of *A. Pinsapo* in the country, but few that excel one of *A. Nordmanniana* at Bicton; it is in perfect health and probably 80 ft. high, its trunk 7 ft. 4 in. in circumference.

The interesting *A. numidica*, rare in cultivation and confined in a wild state to a small area on Mount Babor in Algeria, is represented here by a tree whose dimensions exceed those of any other tree I have seen recorded in this country; I estimated it at some 70 ft. in height and its trunk measured nearly 7 ft. round. Equally as rare as the Mt. Babor fir in cultivation is *A. cilicica;* here at Bicton is one over 50 ft. high and 4 ft. in girth. To us in the dry, hot Thames Valley, where the common silver fir (*A. pectinata*), can scarcely be kept alive, much more grown to any size, no tree at Bicton is more impressive. I measured one as carefully as I could, and made it about 125 ft. high.

Of Japanese firs, *A. brachyphylla* is 4 ft. 10 in. in girth or trunk and some 60 ft. high, its health superb; even finer is a magnificent *A. firma*, 65 ft. high and girthing 5 ft. 9 in.

The Himalayan *A. Pindrow* is about 40 ft. high.

Spruces.—Amongst the spruces (*Picea*), none is finer than two specimens of the Himalayan *Picea Morinda*—also known as *P. Smithiana*—so distinct among its kind for the long, weeping branchlets; the larger one in the Pinetum girths 8 ft. 1 in. and

is perhaps 80 ft. high, the other grows in the garden proper and is not so large, but is clothed with leafy branches to the base and forms a perfect pyramid. Perfect, too, in shape and in health is a splendid tree of *P. orientalis*, 6 ft. 1 in. in girth and probably 80 ft. high; this beautiful spruce is very hardy and one of the most thriving in the London district, and the shortness of its leaves (they are only $\frac{1}{4}$ to $\frac{1}{3}$ in. long), gives its branchlets a very characteristic and graceful appearance. Although introduced nearly sixty years ago, there do not seem to be any large trees of *P. polita* in this country, notwithstanding the fact that it is hardy, succeeds well in a small state and, in Japan, gets to be 70 to 80 ft. high; at Bicton there is a healthy tree 35 ft. high and 3 ft. in girth of stem.

Of the flat-leaved spruces the largest, of course, is *P. sitchensis*, one tree being 13 ft. 6 in. in girth of trunk and, therefore, one of the bulkiest in this country, but like so many other Sitka spruces in cultivation, the large quantities of grey, lifeless twigs towards the base of the tree spoil its appearance as a garden feature. The Japanese flat-leaved spruce known as *P. ajanensis* and *P. hondoensis* (both now regarded by Mr. E. H. Wilson as synonymous with *P. jezoensis*), is represented by a healthy tree 50 ft. or so high. There are smaller trees of the Serbian *P. Omorica* and the Californian *P. Breweriana*.

Araucaria imbricata.—An avenue at Bicton, some 500 yards in length, is the most famous and impressive representation of this Chilean tree in the British Isles. It is formed by fifty trees, twenty-five on each side, and they stand 54 ft. apart in the rows. According to Veitch's "Manual of Coniferae" (Ed. i. p. 195), the avenue was planted in 1843-4 under the direction of Mr. James Veitch. The trees now average about 60 to 70 ft. in height and 7 to 8 ft. in the circumference of their boles. Most of them have lost their lower branches, but this does not detract from the general effect, and reveals the curious wrinkled, swollen base of the trunks.

Amongst junipers the most notable one I saw at Bicton was *Juniperus recurva*, a Himalayan species; this was about 40 ft. high, branching into several stems near the ground; being in fine health it shows the striking pendulous character of the branchlets very well; a smaller one is about 35 ft. high, and both bear fruit freely. Of about the same size is a tree of *J. flaccida*, but not so healthy. There are good plants of the dwarf *J. squamata* and *J. procumbens*; and a plant of the very rare *J. Wallichiana*, only 4 ft. high, but bearing fruit.

There is a very good collection of cypresses, and it has recently been increased considerably by Lord Clinton, who has added many varieties of *Cupressus Lawsoniana*, amongst which is the finest specimen I have seen of the curious variety *Wisselii*—a slender tapering tree about 30 ft. high. Of the more tender cypresses there are *C. torulosa*, a tall columnar tree with a trunk 4 ft. 7 in. in girth; several forms of *C. lusitanica*, one over 50 ft. high; *C. funebris*, perhaps 35 ft. high; and a small *C. cashmeriana*. On the garden lawn, there are fine specimens of *C. thyoides* and *C. sempervirens*.

On the lower part of the garden are two of the finest trees of *Libocedrus decurrens* in the country, making a pair of stately columns; one of them is over 8 ft. in girth of trunk and about 65 ft. high; Elwes mentions another one near the house which is even finer. In the Pinetum is a magnificent *Thuya plicata* (*T. gigantea*), its trunk clothed with rich brown bark and 13 ft. in girth; I estimated its height as between 90 and 100 ft. Even taller are some splendid Douglas firs in groups, one that I measured girthing 11 ft. A redwood (*Sequoia sempervirens*), has a similar girth. It is very unusual to find any but quite young trees of *Cunninghamia sinensis* looking really healthy, and a tree at Bicton, although 60 ft. high and 5 ft. round its bole (and, therefore, one of the biggest in England), is no exception.

To the lover of rare and interesting plants there is no tree at Bicton which will make a greater appeal than *Phyllocladus asplenifolia*. This curious conifer belongs to a genus allied to the yews, but distinguished by curious leaf-like organs of rhomboidal shape termed "phyllodes." Sir Joseph Hooker remarks of the species of *Phyllocladus* that they are remarkable for having "leaves of two forms, some minute and scale-like, others linear, seen only in young plants, but which in older are united into flat fan-shaped organs resembling simple leaves, which bear the inflorescence at their edges." (New Zealand Flora, p. 259.) The tree at Bicton is 32 ft. high, of slender pyramidal form, and in luxuriant foliage and perfect health. I do not know of any other tree in our islands equal to this; it would, itself alone, give distinction to any garden.

Of *Fitzroya patagonica*, from Chile, a not uncommon tree in the south-western counties, a very healthy and symmetrical specimen is 20 ft. high and 10 ft. wide at the base. Another Chilean conifer, *Prumnopitys elegans*, is represented by a tree which must be one of the finest in this country; I estimated it at 36 ft. in height, and the spread of its lower branches is 20 ft.; it was bearing its small male flowers in great numbers.

The Himalayan hemlock (*Tsuga Brunoniana*), is rarely seen in good condition in any but the warmer counties or specially favoured spots; a perfectly healthy tree here is 15 ft. high; and another is in the form of a rounded bush 25 ft. through.

A conifer of which Bicton has reason to be proud is the larger of two Deodars growing on the garden lawn; it is about 80 ft. high and its trunk 13½ ft. in circumference. In regard to the cubic contents of its timber, this is probably the finest tree in the British Isles. In habit it strongly resembles the Cedar of Lebanon, of which also there is a notable tree with a huge trunk 22 ft. 6 in. in girth.

The Arboretum.—The Pinetum at Bicton is so extensive and full of interest, and took up so much of my time, that an inspection of the non-coniferous trees and shrubs was necessarily rather hurried. A full day might profitably be spent with them.

A good deal of interest has in recent years been taken in the South American 'beeches' (*Nothofagus*). The oldest of them in this country is the evergreen *Nothofagus betuloides*, and there are

several fine examples in the south-west, but I have seen none to equal the one here. Its head of branches is over 50 ft. high and about 40 ft. in diameter, and its trunk, which branches low down, measures 9 ft. in girth 18 in. from the ground.

Near the greenhouses is a Black Italian poplar (*Populus serotina*), whose immense trunk is 18 ft. 2 in. in circumference; it is one of the largest in the kingdom. There are also some fine grey poplars (*P. canescens*), in the Arboretum.

At the lower part of the garden there is a remarkable lime tree with very slender, pendulous branches, some of which are 20 ft. in length, yet no thicker at any part than a man's finger. This character is most developed on the lower part of the tree, which is a lofty one with a trunk 14 ft. in girth.

In the collection of oaks founded 70 to 80 years ago there are now many notable specimens. Among evergreen species the rare *Quercus acuta* from Japan is a bush 12 ft. high and 18 ft. in diameter; it was introduced by Maries in 1878. Its ally, *Q. glabra*, also rare and Japanese, is 20 ft. high, 20 ft. through, with the main stem 2 ft. 2 in. in girth; both this and the *Q. acuta* are probably as large as any in the country. Of several forms of Holm oak (*Q. Ilex*), the most striking is the big-leaved variety *latifolia*, with leaves 5½ in. long and 2½ in wide; the tree itself has a trunk 10 ft. 10 in. in girth. Another variety here called "Q. crassifolia," but probably *Q. Ilex* var. *Genabii*, has rounded leaves not so long as those of var. *latifolia*, but 3 in. wide. A fine Lucombe oak is 15 ft. in girth of trunk. Of the common oak there are many fine trees at Bicton; the noblest of them, which unfortunately collapsed some months ago, had a trunk 25 ft. 2 in. in girth at 3 ft. from the ground. There is also a fine specimen of the pendulous *Q. pedunculata*.

A snowdrop tree (*Halesia carolina*), of notable size has a trunk girthing 5 ft. Some interest has recently been taken in the living specimens of the tea plant (*Camellia Thea*), in this country (*see* "Gardeners' Chronicle," Aug. 18, 1917); there are at least three at Bicton which have long been grown in the open air, the largest a bush 8 ft. high and 12 ft. through. A camphor tree (*Cinnamomum Camphora*), is 35 ft. high.

Colletia cruciata is a remarkable shrub from Uruguay which assumes two distinct forms; one is armed—in fact, almost consists of—flat triangular spines 1½ in. wide at the base; the other form has rather bodkin-shaped, comparatively slender spines ½ to 1½ in. long. The large-spined form was first raised at Bicton, and by Lindley was named *C. bictoniensis*. A bush there is now 25 ft. in diameter.

It would be possible to go on naming many other interesting trees and shrubs, such, for instance, as: *Acacia dealbata*, 30 ft. high and in perfect health; *Vaccinium ovatum*, 10 ft. high and 18 ft. in diameter, much the largest I have seen; the Himalayan *Euonymus pendulus*, 8 ft. high and in flower; *Illicium anisatum*, with fragrant leaves and wood and pale yellow flowers; the small leaved form of *Kalmia latifolia*, known as var. *myrtifolia*, 8 ft. high; *Pittosporum tenuifolium*, 30 ft. high; *Magnolia tripetala*,

an old but no longer common species, 28 ft. high and 5 ft. in girth of trunk; and a fine healthy tree of the newer Japanese *M. hypoleuca* over 30 ft. high.

There is a good collection of hardy bamboos on the lower, damper part of the garden, and it was interesting to see *Phyllostachys aurea* flowering, although not gratifying, since it portends the flowering and consequent death of the species throughout the country.

XLIV.—BOCCONIA AND MACLEAYA.

J. Hutchinson.

The genus *Bocconia* (*Papaveraceae*) was founded by Linnaeus* in 1737, the type species being *B. frutescens*† from the West Indies and Central America. Since then several species have been described, of which seven stand as being authentic in the Index Kewensis. These are natives of Central and South America, with the exception of two species, *B. cordata*, Willd., and *B. microcarpa*, Maxim., from North-Eastern Asia. Whilst the close affinity of the floras of North America and North-Eastern Asia has been well established, there is little, if any, connection between those of North-East Asia and South America, and the association of Papaveraceous plants of peculiar type from these two regions in the same genus, were it tenable, would be of considerable phytogeographical interest. That two very distinct genera are involved, however, is shown below.

In the Appendix (p. 218) to the Narrative of Denham and Clapperton (1826), Robert Brown makes the following observation: "Respecting *Bocconia cordata*, though it is so closely allied to *Bocconia* as to afford an excellent argument in favour of the hypothesis in question, it is still sufficiently different, especially in its polyspermous ovarium, to constitute a distinct genus, to which I have given the name (*Macleaya cordata*) of my much valued friend, Alexander Macleay, Esq., Secretary of the Colony of New South Wales, whose merits as a general naturalist, a profound entomologist, and a practical botanist are well known." In spite of this trenchant remark, however, Bentham and Hooker considered *Macleaya* to be congeneric with *Bocconia*, although Endlicher‡ had in 1839 supported the views of Robert Brown, as did also subsequently Prantl§ and, lastly, Fedde. ‖

I give below the differences observable between these two genera, and a revision of the species of *Bocconia* so far as we know them at present.

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* Linnaeus, Gen. ed. i. 32 (1837).

† Linnaeus, Sp. Pl. 505 (1753).

‡ Endlicher, Genera Plantarum, ii. 855 (1839).

§ Prantl in Engl. et Prantl. Natürlich. Pflanzenf. iii. 2, 140 (1889).

‖ Fedde, Monogr. Papaveraceae, 216 (1909).

Bocconia, *Linn.*

Stems perennial. Leaves pinnately nerved or lobed; ovary long-stipitate, with a single basifixed ovule; valves of the fruit fleshy, opening from below upwards; seed large and nearly filling the loculus, surrounded at the base by a large cupular wrinkled aril — *See* text figures A-E.

Macleaya, *R. Br.*

Stems annual. Leaves palmately nerved and lobed; ovary subsessile, with one basal or few parietal ovules; valves of the fruit membranous, opening from the top downwards; seeds small, with a lateral crested aril— *See* text figures F-I.

FIG. A-E—*Bocconia arborea*, Wats.:—A, upper leaf; B, pistil; C, opening fruit; D, seed; E, persistent placentas of fruit; F-H, *Macleaya cordata*, R. Br.; J-I, *Macleaya microcarpa*, Maxim.; leaves ½ nat. size, remainder enlarged.

Clavis specierum Bocconiae.

Folia petiolata:—

Folia plerumque plus minusve pinnatilobata:—

Folia (praesertim superiora) basi acute cuneata, lobis lateralibus angustis acute acuminatis; folia inferiora profunde pinnatipartita:—

Stamina circiter 12; sepala 1 cm. longa; stigmata crassa, 4·5 mm. longa, dense tomentosa ... 1. *B. arborea.*

Stamina circiter 20; sepala circiter 0·8 cm. longa; stigmata angusta, puberula ... ... 2. *B. Pearcei.*

Folia basi plerumque rotundata, lobis lateralibus satis latis apice rotundatis vel breviter acutis (vix acuminatis); folia inferiora haud ultra medium lobata:—
Foliorum inferiorum lobi laterales plerumque 5–10, serrato-dentati:—
Bracteae glabrae vel glabrescentes; stamina 16 ... 3. *B. frutescens.*
Bracteae dense tomentosae; stamina 10 ... ... 4. *B. pubibractea.*
Foliorum inferiorum lobi laterales 2–5, obscure et remote denticulati ... ... 5. *B. latisepala.*
Folia haud lobata, serrata vel crenata:—
Folia infra puberula; nervi laterales numerosissimi:—
Folia obtuse serrato-crenata; species austro-americana ... 6. *B. integrifolia.*
Folia profunde repando-dentata; species centrali-americana ... 7. *B. gracilis.*
Folia infra glauca, glabra ... ... 8. *B. glaucifolia.*
Folia sessilia, crebre et obtuse serrulata; bracteae glabrae; species guatemalensis 9. *B. vulcanica.*

1. **Bocconia arborea,** *Wats.* in Proc. Amer. Acad. xxv. 141 (1890); Fedde Monogr. Papaveraceae, 219 (1909).

Arbor usque ad 8 m. alta; rami annotini fere glabri, circiter 8 mm. crassi, hornotini foliati, lanato-tomentosi. *Folia* inferiora petiolata, profunde pinnatipartita, usque ad 45 cm. longa et 30 cm. lata, supra glabra, crebre reticulata, infra albescentia, papilloso-puberula, lobis lateralibus lineari-lanceolatis usque ad 15 cm. longis et 2·5 cm. latis serratis; folia superiora circiter 15 cm. longa, basi acute cuneata, supra primum lanato-pubescentia, infra praesertim in costa lanata et albido-papillosa, lobis lateralibus ascendentibus acute acuminatis obscure denticulatis vel fere integris; petioli lanato-tomentosi. *Panicula* circiter 20 cm. longa et 12 cm. lata; bracteae oblongo-lineares, subobtuse acuminatae, apice puberulae, usque ad 1 cm. longae; pedicelli fere 1 cm. longi, glabri. *Sepala* oblongo-elliptica, acuminata, 1–1·2 cm. longa, 3–3·5 mm. lata, glabra, marginibus subhyalinis. *Stamina* circiter 12; filamenta filiformia, 2 mm. longa; antherae 7 mm. longae, acutae. *Ovarium* 5 mm. stipitatum, 2 mm. longum; stylus 4 mm. longus, ramis divergentibus 4·5 mm. longis ad basin stigmatoso-puberulis. *Fructus* 7 mm. stipitatus, nutans, ellipsoideus, carnosus, 1 cm. longus, stylo persistente elongato coronatus. *Semina* (immatura tantum visa) basi arillo crustaceo rugoso.

Central America. Mexico: Jalisco State; rich canyons of the mountains near Lake Chapala, young fr. Dec. 1889, *C. G. Pringle* 2445 (type). Morelos State: lava fields above Cuernavaca,

2200 m., fl. Sept. 1900, *C. G. Pringle* 9145; fr. Nov., *C. G. Pringle* 9682. Guatemala: Cunen, Quiche Depart., 2000 m., fls. Apr. 1892, *Heyde & Lux in Donnell Smith Herb.* 2898. Costa Rica: San Jose, 1100 m., *J. D. Smith* 4739; Rio Tirriti, 1100 m., young fr. Mar. 1896, *J. D. Smith* 6430; Mar. 1894, *J. D. Smith* 4739.

2. **Bocconia Pearcei,** *Hutchinson,* sp. nov.

B. frutescens, forma *glaucescens,* Fedde, Monogr. Papaveraceae, 218, partim.

Arbor tenuis, ramosa, usque ad 6 cm. alta, omnibus partibus glaucis succo cinnabarino scatens (*Spruce*); ramuli ultimi glabri, circiter 8 mm. crassi. *Folia* inferiora usque ad 45 cm. longa et 24 cm. lata, profunde pinnatilobata, lobis oblongis subacutis serrato-dentatis, supra glabra, infra albida, crispato-puberula; costa infra sulcata, circiter 6 mm. lata; folia superiora basi longe cuneata, paucilobata, breviter petiolata, circiter 25 cm. longa et 14 cm. lata. *Panicula* magna, usque ad 40 cm. longa, ramosissima; bracteae oblongo-lanceolatae, subacute acuminatae, pedicellis circiter dimidio breviores, marginibus puberulis; pedicelli graciles, 0·8–1 cm. longi, glabri. *Sepala* elliptica, brevissime abrupte acuminata, 1–1·2 cm. longa, glabra. *Stamina* circiter 20; filamenta filiformia, 2 mm. longa; antherae 7 mm. longae. *Ovarium* 5 mm. stipitatum, 2·5 mm. longum; stylus 4 mm. longus, stigmatibus acutis circiter 3 mm. longis breviter puberulis. *Fructus* glaucus, ellipsoideus, circiter 1 cm. longus, longe stipitatus, stylo persistente 5 mm. longo coronatus. *Semina* nigra, 6·5 mm. longa, arillo coccineo.

South America. Bolivia: Yungas, fr., *M. Bang* 441. Corvico, May 1866, *Pearce* (type). Peru: near the River Alau, at the foot of Mt. Campana, in moist woods, fr., Nov. 1855, *R. Spruce* 4301.

This species will be found in herbaria under *B. frutescens,* which it resembles very closely. Their differences are shown in the key.

3. **Bocconia frutescens,** *Linn.* Sp. Pl. 505 (1753); Lam. Encyc. i. 432; Ill. t. 394; Descourt. Fl. Ant. i. t. 54; Macf. Jam. 22; Griseb. Fl. Br. W. Ind. 13; Urb. Symb. Ant. iv. 250; Fedde, Monogr. Papaveraceae, 216, partim.

B. glauca, Salisb. Prodr. 397 (1796). *B. quercifolia,* Moench. Meth. Suppl. 122 (1802). *B. sinuatifolia,* Stokes, Bot. Med. iii. 8 (1812). *B. subtomentosa,* L'Herit. ex Stahl, Estud. Fl. Puertorico Foll. ii. 34 (1884). *Bocconia ramosa,* etc., Plum. Gen. 35, t. 25 (1703). *Chelidonium majus arboreum,* etc., Sloan, Jam. 82; Hist. i. 196, t. 125 (1707).

Frutex; ramuli ultimi lanato-pubescentes. *Folia* inferiora petiolata, fere ad medium pinnatilobata, basi truncata vel rotundata, 15–35 cm. longa, 10–20 cm. lata, tenuiter membranaceo-chartacea, supra glabrescens, infra primum subdense demum laxe crispato-tomentosa, pallida, lobis oblongis subacutis repando-denticulatis; folia superiora minus lobata vel subintegra; petioli 3–7 cm. longi, tomentosi. *Panicula* usque ad 40 cm. longa,

laxe ramosa; bracteae oblongo-lanceolatae, acute acuminatae, pedicellis multo breviores, marginibus puberulis; pedicelli circiter 1 cm. longi, graciles, glabri. *Sepala* oblongo-elliptica, abrupte obtuse acuminata, circiter 1 cm. longa. *Stamina* circiter 16; filamenta filiformia, 3·5 mm. longa; antherae 6 mm. longae. *Ovarium* 4·5 mm. stipitatum, 3 mm. longum; stylus 1 mm. longus, stigmatibus 2·5 mm. longis recurvatis breviter tomentosis. *Fructus* anguste ellipsoideus, utrinque acutus, 7–8 mm. longus, carnosus, longe stipitatus, stylo persistente coronatus. *Semina* 6 mm. longa, leviter muricata, basi arillo crustaceo cincta.

West Indies. Cuba: *Wright* 6; rocky slope, San Antonio de los Banos, Havana Province, Mar. 1905, *A. H. Curtiss* 687. Jamaica: banks of rivers everywhere, *Purdie*; Moneague, Dec. 1849, *Alexander Prior*; St. Marys, 1839, *McNab;* without locality, *McFadyen*; *J. Bryce*; *Distin*; *Marsh* 876. Santo Domingo, *Schomburgk*; *Eggers* 1742. *Porto Rico*: *Sintenis* 181. Martinique: *Sieber* 129. Dominica: *Eggers* 4182.

Central America. Mexico: Tamasopo Canyon, San Luis Potosi State, shrub 5–15 ft., Nov. 1890, *E. G. Pringle* 3374. Vera Cruz, Mar. 1839, *Linden* 28. Vera Cruz to Orizaba, *F. Mueller*. Xalapa, Mar. 1840, *Galeotti* 7007. Vallee de Cordova, Jan. 1866, *Bourgeau* 1750; without definite locality, *Jorgensen* 492. Guatemala: Misco, 2000 m., Apr. 1890, *Donnell Smith* 2177; Acatepeque, 1400 m., Mar. 1892, *Donnell Smith* 2505.

4. **Bocconia pubibractea,** *Hutchinson*, sp. nov.

Frutex sempervirens 5–6·5 m. altus (*Pearce*); ramuli ultimi primum lanato-pubescentes mox glabri. *Folia* inferiora petiolata, pinnatilobata, circiter 40 cm. longa et 18 cm. lata, membranaceo-papyracea, supra mox glabra, infra praesertim in nervis et venis lanato-pubescentia, lobis usque ad 4 cm. longis triangulari-oblongis apice rotundatis marginibus crenatis; folia superiora non visa; petioli 6–7 cm. longi, circiter 5 mm. lati, lanato-pubescentes. *Panicula* gracilis, laxiflora, circiter 40 cm. longa, ubique lanata; bracteae demum subglabrescentes, oblongo-lanceolatae, acute acuminatae, pedicellis multo breviores; pedicelli graciles, 1–1·5 cm. longi. *Sepala* obovato-elliptica, abrupte acute acuminata, 1 cm. longa, glabra. *Stamina* 10; filamenta filiformia, 1·5 mm. longa; antherae 4 mm. longae. *Ovarium* 3 mm. stipitatum, 2 mm. longum; stylus 2 mm. longus, stigmatibus 5 mm. longis recurvatis. *Fructus* ellipsoideus, carnosus, 1 cm. longus, siccitate valde rugosus, longe stipitatus, stylo persistente 7 mm. longo coronatus.

South America. Colombia: slopes of mountains about Muña, 2600–3600 m., May 1863, *Pearce* (type). Boqueron, mountains near Bogotà, 16 Nov. 1852, *I. F. Holton* 679: *Triana* 157. Andes of Popayan, 1700–2500 m., *Lehmann* 555; 5102.

5. **Bocconia latisepala,** *S. Wats.* in Proc. Am. Acad. xxv. 141 (1890); Fedde, Monogr. Papaveraceae, 219 (1909).

Herbacea usque ad 2 m. alta; rami juniores glabri, caeruleo-glauci. *Folia* inferiora longe petiolata, usque ad 25 cm. longa et 12 cm. lata, 3–4-pinnatilobata, tenuiter chartacea, supra glabra,

infra crispato-pubescentia, glauca, lobis lateralibus oblongis apice rotundatis remote et obscure denticulatis; petioli 5–5·5 cm. longi, longitudinaliter sulcati, glauci. *Panicula* usque ad 30 cm. longa, e basi laxe ramosa; bracteae oblongo-lanceolatae, subacutae, pedicellis multo breviores, marginibus puberulis; pedicelli 2–3 mm. longi, glauci, glabri. *Sepala* valde imbricata, late elliptica, circiter 6 mm. longa, abrupte acuminata, glabra, glauca. *Stamina* 12–14; filamenta filiformia, 1·5 mm. longa; antherae 4 mm. longae. *Ovarium* 3 mm. stipitatum; stylus 2·5 mm. longus, crassus, ramis curvato-divergentibus 3 mm. longis. *Fructus* 8–10 mm. stipitatus, nutans, ellipsoideus, carnosus, 1 cm. longus, stylo persistente 7 mm. longo coronatus, valvis demum deciduis. *Semina* ellipsoidea, 8 mm. longa, basi arillo crustaceo 2 mm. longo cincta.

Central America. Mexico: Guajuco, fl., *E. Palmer* 23. Nuevo Leon State; rich shaded canyons of the Sierra Madre, near Monterey, 3 July, 1888, *C. G. Pringle* 1907. *Hort. Gouan.*

6. **Bocconia integrifolia,** *Humbl. & Bonpl.* Pl. Aequin. i. 119, t. 35 (1805).

Frutex ramosissimus, usque ad 5 m. altus; ramuli juniores circiter 1·3 cm. crassi, farinaceo-pubescentes. *Folia* breviter petiolata, elongato-elliptica, apice triangularia, usque ad 30 cm. longa et 10 cm. lata, serrata vel crenata, rare apicem versus paucilobata, tenuiter chartacea, reticulata, supra glabra, infra albida, papilloso-puberula; costa infra valde prominens, basin versus sulcata; nervi laterales utrinsecus usque ad 18, leviter arcuati, bifurcati et multiramosi; petioli 2–3 cm. longi, supra concavi et dense lanato-tomentosi. *Panicula* multiflora, ad 35 cm. longa; bracteae inferiores foliaceae, magnae, ultimae oblongo-lanceolatae, subobtusae, glabrae, pedicellis dimidio breviores; pedicelli 5–7 mm. longi. *Sepala* obovato-elliptica, abrupte acuminata, 1 cm. longa, glabra. *Stamina* circiter 10; filamenta filiformia, circiter 2 mm. longa; antherae 5 mm. longae. *Ovarium* 3 mm. stipitatum; stylus 2 mm. longus, stigmatibus crassis valde recurvatis. *Fructus* carnosus, ellipsoideus, circiter 1·3 cm. longus. *Semina* oblongo-ellipsoidea, 6 mm. longa, basi arillo crustaceo verrucoso 2 mm. longo cincta.

South America. Colombia: Chipaque, Bogotà, 2400 m., *J. Triana.* Bogotà, Jan. 1846, young fr., *Purdie.* Bolivia: near Sorata, 2650–2800 m., Feb.-Mar. 1860, *G. Mandon* 886. Peru: near Cascas, *Humboldt & Bonpland* (type)—not seen.

7. **Bocconia gracilis,** *Hutchinson,* sp. nov.

Rami crispato-pubescentes, internodiis circiter 1 cm. longis. *Folia* elliptico-oblanceolata, acute acuminata, basi breviter cuneata, 8–16 cm. longa, 3–6 cm. lata, chartacea, subdupliciter repando-serrata, supra glabra, infra crispato-puberula; nervi laterales utrinsecus 9–12, arcuati, prominuli; petioli 2–2·5 cm. longi, minute puberuli. *Panicula* pauciflora, laxa, usque ad 20 cm. longa; bracteae lineari-lanceolatae, acutae, pedicellis dimidio breviores, extra minute puberuli; pedicelli 1–1·5 cm. longi, mox glabrescentes. *Sepala* obovata, abrupte acuminata, glabra, fere

1 cm. longa. *Stamina* 12; filamenta 2 mm. longa, filiformia; antherae 5 mm. longae. *Ovarium* 5 mm. stipitatum, 2 mm. longum; stylus 3 mm. longus, stigmatibus 3 mm. longis mox recurvatis. *Fructus* non visus.

Central America. Guatemala: Pansamalá, Alta Verapaz Department, 1300 m., fls. May 1887, *H. von Tuerckheim in Herb. Donnell Smith* 1236.

Mr. J. Donnell Smith has identified this species with the unpublished figure of *B. frutescens, var. cernua*, DC., in Mocino & Sessé Fl. du Mex. t. 14, which, however, differs in having lobed leaves.

8. **Bocconia glaucifolia,** *Hutchinson*, sp. nov.

B. integrifolia, var. *mexicana*, DC. Prodr. i. 121 (1824)?

Ramuli glabri, glauci, internodiis vix 1 cm. longis. *Folia* oblongo-oblanceolata, acute breviter acuminata, basi valde inaequalia et rotundata, 7–12 cm. longa, 2–4 cm. lata, tenuiter chartacea, serrata, glabra, infra conspicue glauca; nervi laterales utrinsecus 14–16, graciles, arcuati; petioli 1·5–2 cm. longi, glauci. *Panicula* pedunculata, usque ad 35 cm. longa, laxiflora; bracteae oblongo-lanceolatae, subobtuse acuminatae, ultimae circiter 5 mm. longae, glabrae; pedicelli circiter 8 mm. demum 10 mm. longi, robusti. *Sepala* late elliptica, subacute acuminata, circiter 1 cm. longa, glabra. *Stamina* circiter 12; filamenta filiformia; antherae 5 mm. longae. *Ovarium* 5 mm. stipitatum, 2 mm. longum; stylus 4 mm. longus, stigmatibus 4 mm. longis crassis spiraliter contortis. *Fructus* non visus.

Central America. Guatemala: San Miguel Uspantán, Quiché Department, about 2600 m., Apr. 1892, fl., *Heyde & Lux in Herb. Donnell Smith* 2899.

9. **Bocconia vulcanica,** *J. D. Smith* in Bot. Gaz. xvi. 1 (1891); Fedde, Monogr. Papaveraceae, 220 (1909).

Arbor; ramuli apice dense foliati, circiter 8 mm. crassi, glabri. *Folia* sessilia, obovata vel elliptico-obovata, subacute et abrupte acuminata, 10–14 cm. longa, 4–5·5 cm. lata, tenuiter chartacea, crebre et obtusissime serrata, utrinque glabra; nervi laterales numerosi, graciles, arcuati. *Panicula* densiflora, pedunculata, usque ad 25 cm. longa; bracteae oblongo-lanceolatae, acutae, pedicellis breviores, glabrae; pedicelli circiter 5 mm. longi, robusti. *Sepala* elliptica, caudato-acuminata, 1 cm. longa, subcoriacea, glabra. *Stamina* 10–15; filamenta filiformia, 2 mm. longa; antherae 5–6 mm. longae. *Ovarium* 2 mm. stipitatum, 3 mm. longum, glaucum; stylus crassus, 1·5 mm. longus, stigmatibus 3 mm. longis acutis. *Fructus* immaturus glaucus, carnosus.

Central America. Guatemala: Volcan de Agua, Zacatepequez, 3200 m., Apr. 1890, *Donnell Smith* 2172 (type).

Imperfectly known species.

B. ferruginea, *Roezl* in Belg. Hort. xxiv. 39 (1874)—Peru—nomen nudum.

Macleaya, *R. Br.* in Denham et Clapp. Narrat. Append. 218 (1826); Fedde, Monogr. Papaveraceae, 215 (1909).

Stamina 25–30; capsula oblanceolata, seminibus 4–6 ad suturas sessilibus ... 1. *M. cordata.*
Stamina 8–12; capsula orbicularis, semine solitario basifixo erecto ... ... 2. *M. microcarpa.*

1. **Macleaya cordata,** *R. Br.* l.c.; Franch. et Savat. Enum. Pl. Jap. i. 27 (1875); Fedde, Monogr. Papaveraceae, 216, Fig. 27, A–G, incl. var. *yedoensis,* Fedde (1909).

Bocconia cordata, Willd. Sp. Pl. ii. 841 (1797); Bot. Mag. t. 1905 (1817); DC. Prodr. i. 121 (1824).

China. Western Hupeh: *E. H. Wilson* (Veitch Exped.) 1403. Patung District, *A. Henry* 3162, 5213. Nanto and mountains to northward, *A. Henry* 1882. Shansi Province: Ta ho kuan, *F. N. Meyer* 1870. Chekiang: Hang-chow, *H. J. Hickin.* Hillsides, Chekiang, July 1854, *Fortune.*

Japan. Tokyo, *Science Coll. Imp. University (Japan) Herb.* Yokohama, *Maximowicz; Oldham* 216. Yokoska, *Savatier* 58. Aomori, *Faurie* 578. "Central Mts.," *Maries.*

2. **Macleaya microcarpa,** *Fedde* in Engl. Bot. Jahrb. xxxvi. Beibl. 82, 45 (1905); Monogr. Papaveraceae, 217, fig. 27, J–O (1909).

Bocconia microcarpa, Maxim. in Act. Hort. Petrop. xi. 45 (1889).

China. Eastern Kansu: *Potanin* (1885). *Hort. Kew.* 1895. Northern Shensi: *Giraldi* 760, 4468–4472 (ex Fedde).

XLV.—BAMBOOS AND BORING BEETLES.

L. A. Boodle & W. Dallimore.

The fact that Bamboos used in India for building purposes in the normal condition are very liable to injury by boring beetles, whereas those that have been well soaked in water before use are usually left alone, led to the following experiments being made with a view to determining the reason.

The material used in the experiments was grown in the Royal Botanic Gardens, Kew, part being examined in a fresh state, part after soaking for three months in the pond near the Palm House, and part after soaking for three months in water heated to 80° Fahr. in the tank in the Victoria Regia House, the examination in each case being conducted in the Jodrell Laboratory.

Examination of two portions of Bamboo stem (Dendrocalamus giganteus), from the Palm House, one fresh and one after being sunk in the pond near the Palm House for three months.

The untreated piece of stem contained abundant starch, and a considerable amount of soluble carbohydrate, consisting of or including glucose or some other sugar, giving a precipitate with Fehling's solution.

In the stem from the pond, soluble carbohydrate was present in

extremely small quantity, and may perhaps have consisted of glucose, as it may have been insufficient to detect by Fehling's reaction in the small amount of material used for examination. The quantity of starch is, on the whole, considerable, though decidedly less than in the other specimen, and also varying a good deal locally. Starch had practically disappeared from the cut end of the stem for a distance of 2–3 mm., and was most abundant towards the middle of the length of the specimen.

If the presence of a considerable amount of starch were a necessary condition of attack by the boring insect, the treated specimen would probably meet the requirements, but it must be remembered that the removal of starch from a piece of stem immersed in water might be more rapid in a hot climate.

The possibility that sugary contents might render the stem liable to attack is countenanced by the approximate absence of sugar in the soaked specimen. For comparison, a piece of small-stemmed bamboo (received from Mr. J. C. Fryer, Entomologist to the Ministry of Agriculture), actually attacked by *Dinoderus minutus*, F. (the commonest boring beetle attacking dry bamboo-stems in India, etc.), was examined. Sugar in this specimen was relatively scanty, but probably not sufficiently so to justify the rejection of sugar as a possible factor favouring attack. As far as nourishment is concerned, it may be supposed that certain kinds of boring beetles can obtain sufficient from the digestion of woody fibre, apart from the presence of sugar or starch.

The matter has been discussed with Mr. Fryer, who holds the opinion that scent is the special factor determining attack, that is to say that some odour, perceptible to the insect concerned, is the means by which it recognises the stem as bamboo, or as one of the plants which it attacks, and that if this scent is removed or sufficiently masked, the plant is avoided.

The effect of soaking in water might be to remove some chemical compound on which the odour depends, or, if the matter is one of masking, this might be due to an added scent, either produced by decomposition of some component of the wood, or absorbed from the water, if, for instance, the wood is sunk in a pond containing decaying organic matter.

The specimen from the pond had at first a very offensive smell, and still retains some of it, the smell being rather suggestive of organic sulphur-compounds. Though the mud of the pond may be responsible for this, it should be noted that a Bamboo (*Bambusa arundinacea*), is quoted as having a rather high sulphur-content in the ash of its leaves, 10·7 per cent. reckoned as SO_3, as against 3–6, representing commoner values.

Examination of sections of the same stem soaked in water at a temperature of 80° Fahr. for three months.

An experiment was also made by soaking pieces of bamboo in the *Victoria regia* tank for three months. This treatment was found to remove all the sugar present, but only a small proportion of the starch.

One may assume that, in the case of similar treatment in a hot climate, a stem, originally containing abundant starch, would

still contain plenty after soaking, but that all the sugar, or most of it, would disappear. It may be concluded also that immunity from attack would not be due to such reduction in starch-content as takes place, but that the removal of sugar may perhaps be the change which confers immunity.

The following experiment was carried out with a view to testing the value of these deductions:—

Three boring beetles (*Dinoderus minutus*), were placed in a corked glass-tube with three strips of bamboo. The pieces of bamboo were from a stem containing abundant starch and a considerable quantity of sugar. One of the strips was untreated, while the other two had been soaked in the pond, and had thus lost most of their sugar. After six days it was found that all three beetles had bored into the untreated piece, one having first made a short burrow in one of the treated pieces. The effect of soaking is thus comparable to that obtained in India. The fact that one beetle made a preliminary boring in a treated piece, when there was plenty of untreated bamboo at hand, does not appear to favour the suggestion, made in describing the first experiment, that immunity might depend on the removal or masking of some characteristic odour possessed by the bamboo. An increased probability therefore attaches to the view that the removal of sugar may be the determinant.

A second untreated strip was placed in the tube with the beetles; this also was attacked, a new brood of beetles was produced, and eventually the material of both untreated pieces became nearly exhausted, when a slight further attack of the treated piece took place.

Further experiments were prevented from being carried out by the death of the beetles.

The powder produced by the beetles in boring an untreated piece of bamboo, in which starch and sugar were abundant, was found to contain, besides the woody fibre, plenty of starch, but only a very small amount of sugar. Practically all this powder had no doubt passed through the alimentary canal of the insects, but some fragments which had not been ingested may have been present, and possibly the sugar detected may have belonged to these.

Further Experiments.

Four more beetles having been obtained, they were put into two jars with treated and untreated pieces of bamboo, three beetles in one jar (A), and one beetle in another jar (B). In both cases the piece of bamboo attacked by the insects was an untreated one containing plenty of starch and a considerable amount of glucose. In both cases also a small boring had been first begun in a treated piece from the same stem, that in jar B having been soaked in the pond, most of the glucose being thus removed, while the piece slightly bored in jar A was one which had been similarly treated and afterwards soaked in glucose solution (5 per cent.) and dried. Thus untreated material was preferred to treated, even when glucose had been restored to the treated bamboo. It is possible, however, that an unsuitable

amount of glucose may have been added, or that the re-sugared material may have been insufficiently dried.

It is to be noted that both the bamboo attacked and that visibly sampled by the beetles contained starch. The other pieces of bamboo included in the jars and apparently untouched were as follows:—In jar B.—Untreated pieces from two thinner-stemmed bamboos, having no starch and very little glucose. It is not surprising that these did not prove attractive. In jar A.—(1) Untreated, thin-stemmed, no starch and little sugar; (2) untreated, rather thin-stemmed, no starch, plenty of glucose; (3) thin-stemmed, no starch, originally very little sugar, but treated by soaking in glucose-solution; (4) thick-stemmed, soaked in *Victoria regia* tank, starch present.

The attack of starch-containing material and the absence of any boring in untreated bamboo, in which there was plenty of glucose but no starch, may indicate a preference for a diet containing starch. It is possible, however, that the sugary but starchless specimen was rejected because it was from a thin-stemmed bamboo. The fact that all the specimens definitely attacked, as well as those in which small borings were begun, were from the same thick-stemmed bamboo, may have some significance. Perhaps thick-stemmed material is chosen first for a trial, if at hand, or preference may be given to certain species of bamboo.

These later experiments scarcely help towards a general conclusion. The tentative boring of treated bamboo, however, is confirmed, and, as this was more than a mere tasting of the material, it appears that the bamboo was not unpalatable, but that the short boring probably served as a trial of its nutritive quality. The latter was apparently found to be below standard, presumably on account of the very small amount of sugar present. There is thus some probability that the removal of most of the sugar is the action by which soaking in water renders bamboo unattractive to boring beetles, and it may be supposed that the experiment with re-sugared bamboo was in some way an unsatisfactory one, perhaps owing to insufficient drying.

XLVI.—MISCELLANEOUS NOTES.

Mr. J. S. J. McCall, Director of Agriculture, Nyasaland Protectorate, has been appointed by the Secretary of State for the Colonies, Director of Agriculture in the Tanganyika Territory.

Mr. E. J. Wortley, F.C.S., Director of Agriculture, Bermuda, has been appointed by the Secretary of State for the Colonies, on the recommendation of Kew, Director of Agriculture in the Nyasaland Protectorate, in succesSsion to Mr. McCall.

Mr. F. M. Rogers, a member of the gardening staff of the Royal Botanic Gardens, has been appointed by the Secretary of State for the Colonies, on the recommendation of Kew, Head Gardener at the Amani Institute, Tanganyika Territory.

Mr. C. Matthews, a member of the gardening staff of the Royal Botanic Gardens, has been appointed by the Secretary of State for India in Council, on the recommendation of Kew, a Gardener in the United Provinces, India.

Mr. J. W. Besant, a former member of the gardening staff of the Royal Botanic Gardens, Kew, and for some time Foreman in the Royal Botanic Gardens, Glasnevin, has been promoted to the post of Assistant to the Keeper, Royal Botanic Gardens, Glasnevin.

Mr. James Reid, a probationer forester in the Royal Botanic Garden, Edinburgh, has been appointed by the Secretary of State for the Colonies, on the recommendation of Kew, Forest Officer in the Falkland Islands.

Lady Hanbury.—We record with deep regret the death of Katherine Aldam, Lady Hanbury, widow of Sir Thomas Hanbury, of La Mortola, on 2nd September, at Castle Malwood, Lyndhurst.

It was Lady Hanbury's constant care to maintain La Mortola as a garden of scientific value and to develop it on the lines laid down by Sir Thomas. This aim she fulfilled in a remarkable degree as she sought every means of enriching the collections and of making the resources of the gardens as widely available as possible. Among the latest interests was her desire to establish the Maté plant, *Ilex paraguayensis*, at La Mortola.

With Kew, Lady Hanbury always maintained very close associations, very greatly to the benefit of this institution, since she was always ready to supply specimens and seeds of rare and interesting plants from the collections. Kew was also able to communicate tender plants for trial in the open in the more genial climate of the Riviera.

It was characteristic of her generous and unselfish nature that she felt that her priceless heritage must be shared as fully as possible, and to this end both botanists and the public generally were given free access to the gardens. In addition to this the hospitality of La Mortola was extended by Lady Hanbury to many to whom the sunshine and ease might result in restored bodily health. To such guests the charm and kindness of their hostess must have ensured far more than physical betterment.

Of her kindly consideration and loving care for all her employees and for the villagers and peasants of La Mortola and the countryside, it is for others to speak, but her wonderful love

of doing good whenever possible, with a studied avoidance of all ostentation, will ever remain as a beautiful memory in the hearts of all those whose privilege it was to have known her.

Botanical Magazine.—The following plants have been figured in the six numbers for the months January to June of this year. *Stanhopea Costaricensis*, Reichb. f. (t. 8830) from Costa Rica; *Rhododendron ledoides*, Balf. f. et W. W. Sm. (t. 8831) from Yunnan; *Ilex verticillata*, A. Gray (t. 8832) a native of Eastern North America; *Cornus Kousa*, Buerg. MSS. apud Miq. (t. 8833) from North Eastern Asia; *Rhododendron vernicosum*, Franch. (t. 8834) from Western China; *Erica Haroldiana*, Skan (t. 8835) from South Africa; *Primula pulvinata*, Balf. f. et Ward (t. 8836), a native of Yunnan; *Symphyandra asiatica*, Nakai (t. 8837) from Corea; *Pavetta abyssinica*, Fresen. (t. 8838) from East Tropical Africa; *Pleurothallis punctulata*, Rolfe (t. 8839) from Colombia; *Ribes Jessoniae*, Stapf (t. 8840) from Western China; *Rhododendron serotinum*, Hutchinson (t. 8841) also a native of Western China; *Bulbophyllum macrobulbum*, J. J. Sm. (t. 8842) from New Guinea; *Hoheria populnea*, A. Cunn. var. *lanceolata*, Hook. f. (t. 8843) from New Zealand; *Iris Hoogiana*, Dykes (t. 8844) from Turkestan; *Venidium macrocephalum*, DC. (t. 8845) a native of South Africa; *Metrosideros collina*, A. Gray (t. 8846) from Polynesia; *Lilium Farreri*, Turrill (t. 8847) from China; *Salvia brevilabra*, Franch. (t. 8848) from Western Szechuan; *Ribes niveum*, Lindl. (t. 8849) a native of North-West America; *Podophyllum Emodi*, Wall. var. *chinense*, Sprague (t. 8850) from Western China, and *Rhododendron lutescens*, Franch. (t. 8851) also from Western China.

Sir J. D. Hooker.*—The Society for Promoting Christian Knowledge has published an admirable sketch of the life of Sir J. D. Hooker, by Professor F. O. Bower, which forms a volume of its "Pioneers of Progress" (Men of Science) series. In a paper wrapper it may be purchased for a shilling, and as the matter is compressed as much as possible, without, however, neglecting any of the more important features of Sir Joseph's long and active life, the volume may be read through in an hour or two. After a brief but interesting Historical Introduction, Professor Bower gives his record in chapters, entitled: Birth and Education, Foreign Travel, Kew, Authorship, The Species Question, Personal Characteristics, and Hooker's Position as a Man of Science. At the end is a useful list of the dates of the greater events in Sir Joseph's career, followed by a select list of his portraits and a brief bibliography. The portrait appearing in this volume has not, so far as we can ascertain, been published before.

We have noted a mistake regarding the area of Kew Gardens—a mistake so obvious that no reader knowing Kew at all well would

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* Joseph Dalton Hooker, O.M., &c., by Prof. F. O. Bower, Sc.D., F.R.S., London (S.P.C.K.), 1919, 62 pages and portrait. 1s. in paper wrapper, 2s. cloth.

be deceived by it. On p. 26 it is stated that "at the present day some 650 acres are under the Director's control." The precise area of the Gardens is 288 acres and 2 rods. A trivial slip occurs on p. 59. Sir Joseph's funeral took place on Friday, December 15, 1911 (not December 17).

Practical Plant Biochemistry.*—A proof of the advance in scientific knowledge within recent years has been the bridging over of many of the artificial gaps by which the various branches of science have been separated one from another. Correlated with this are the unexpected nature and the practical and academical importance of the discoveries which have been made in the past few decades on the borderland of two or more sciences. The result to the student of botany in particular has been an enormous increase in the subject matter with which he has to become acquainted. None of the more recent subdivisions of botany can show greater advance than plant chemistry, either in number or importance of discoveries. For this reason, if for no other, Mrs. Onslow's book "Practical Plant Biochemistry" would be welcomed. The work is primarily designed as a text-book for laboratory work, and in this respect is supplementary to "The Chemistry of Plant Products" by Haas and Hill. General statements and discussions are followed by definite instructions for enabling the student to extract from the plant itself the chemical compounds under consideration and to learn something of their properties. One hundred and fifty-eight such experiments are detailed. There is an all too brief chapter on "the Colloidal State," in which the general outlines of colloidal chemistry are given. This chapter might with advantage have been extended, although perhaps its subject belongs to physics rather than to chemistry. As one would naturally expect, consideration of the enzymes occupies a prominent place, and, besides a chapter on "Enzyme Action," the enzymes acting on each main group of compounds are considered after the chemical constitution of each group of compounds has been investigated. Thus we have carbohydrates and their hydrolyzing enzymes, fats and lipases, aromatic compounds and oxidizing enzymes, proteins and proteases, glucosides and glucoside-splitting enzymes. It would, perhaps, have unduly extended both the scope and the bulk of the book, but one cannot help feeling that it would have been more useful and certainly more interesting to the general botanist if fuller information from the physiological standpoint had been given and the position which the various compounds probably hold in the plant's system of metabolism indicated. A select bibliography is given at the end of each chapter.

W. B. T.

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* Practical Plant Biochemistry. Muriel Wheldale Onslow, Cambridge University Press, 1920. 15s.

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